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MINISTRY FOR ECONOMIC AFFAIRS

PATENT

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The Minister for Economic Affairs,

Whereas the law as of March 28th on patents, notably article 22;

Whereas the Royal Decree as of December 2nd 1986 relating to the application, the issuance, the maintaining in force of patents, notably Article 28;

Whereas the report drawn up on February 3rd at 2.40pm at the Office de la Propriété Industrielle (Belgian Patent Office).

RULES:

Article 1.- To : ION BEAM APPLICATIONS SA, Chemin du Cyclotron 3, B-1348 LOUVAIN-LA-NEUVE (BELGIUM)

represented by: VAN MALDEREN Joëlle, OFFICE VAN MALDEREN, Place Reine Fabiola 6/1 – B 1083 BRUSSELS

a patent is issued with a duration of 6 years, subject to payment of the yearly fees, for: DEVICE INTENDED FOR PRODUCING RADIO-ISOTOPES.

Article 2.- This patent is delivered without prior examination of the patentability of the invention, without any guarantee on the merit of the invention or on the exactness of the description of the latter and at the risk of the applicant(s).

Brussels, June 1st 1999
by special delegation

L. [illegible]
CONSEILLER

DEVICE INTENDED FOR PRODUCING RADIO-ISOTOPES

Object of the invention

The present invention relates to a device intended for producing radio-isotopes such as for example fluorine-18.

Technological background on which the invention is based

Certain radio-isotopes which have an application in nuclear medicine, the most known example of which is fluorine-18, are produced by bombardment with a beam of charged particles, and more particularly of protons, on a target which is positioned in a cavity. This beam of charged particles stems from an accelerator such as for example a cyclotron. The cavity which comprises the target is "hollowed out" in a metal part. The interaction of the charged particles from the beam with the target formed by an enriched isotope generates the nuclear reaction intended for producing the radio-isotope.

Because of an always increasing demand for radio-isotopes, these targets should always produce more radio-isotopes. This increase in production may either be accomplished by modifying the energy of the beam of charged particles, and in this case, the cross-section of the nuclear reaction is increased or by modifying the intensity of the beam of particles, and in this case, this is a change in the number of accelerated particles hitting the target. Both of these parameters are not independent and will interact via a physical relationship which is expressed through the power dissipated in the target:

$$P\ (\text{Watt}) = E\ (\text{MeV}) \times I\ (\mu\text{A})\ (1)$$

with:

- P = power expressed in Watts

- E = energy of the beam expressed in MeV (million electron volts)
- I = intensity of the beam expressed in μA (micro-amperes).

The factor limiting the production in a target is therefore the power which is dissipated therein. Various improvements have been proposed in order to increase this power.

Object of the invention

The present invention aims at proposing a device intended for producing radio-isotopes obtained by bombarding a target with particles from a beam of charged particles stemming from a particle accelerator such as a cyclotron, which in particular has improved cooling properties.

Characteristic elements of the present invention

The present invention relates to a device intended to producing radio-isotopes, comprising a cavity in which the target is positioned, characterized in that said cavity has external walls with a hemispherical shape.

Preferably, this device comprises an insert in which the cavity is made comprising external walls, the shape of which is adapted to that of a diffuser so as to create a channel in which a coolant fluid moves.

In a particularly advantageous way, the shape of the channel created between the diffuser and the external walls of the cavity is also hemispherical.

Short description of the figures

Fig. 1 illustrates a sectional view along a longitudinal axis of a target used according to the present invention,

Fig. 2 illustrates an exploded view of different mechanical elements intended for producing the target as described in Fig. 1.

Detailed description of a preferred embodiment of the invention

Figs. 1 and 2 illustrate a target used for generating radio-isotopes which will be used in nuclear medicine, in particular fluorine-18 which will be produced by the reaction ^{18}O (p,n) ^{18}F.

In order to produce this reaction, a beam of charged particles is sent on a target which is present in a cavity 1. With the subsequent reaction it will be possible to obtain the desired radio-isotope. This target may be a liquid or gas target or further even a solid target. Conventionally, the target is maintained in a cavity or a vacuum chamber.

It is mandatory to cool the cavity containing the target. Usually, cooling is accomplished by means of a heat exchanger in which water circulates.

According to the present invention, it is proposed to force a coolant fluid, and generally simply water, along the external surface 4 of the irradiated cavity in order to promote heat exchange.

For this purpose, a part called a "diffuser" 3 is affixed, which is provided for the making of a channel 2 parallel to the walls of the cavity 1. With the diffuser, it is possible to obtain flow of the coolant fluid while increasing the heat exchange surface area.

The walls of the cavity 1 are made with an insert 8 in solid silver or in titanium, while the diffuser 3 is made in a preferably conducting material such as copper.

As illustrated in Fig. 1, it is observed that the coolant fluid is introduced into the target element through the inlet 10. This coolant fluid is immediately brought into contact with the external walls 4 of the cavity to be irradiated 1 in order to promote heat exchange between this cavity 1 and the fluid.

The insert 8 is designed so as to create a channel 2 between the external walls of the cavity 1 and diffuser 3, the shape of this channel preferably being hemispherical. The shape of the insert 8 should further be designed so as to allow a path 7 for the coolant fluid towards an outlet 20. The whole of the insert parts 8, diffuser 3 and various parts with which the inlet and outlet may be created for the coolant fluid, is maintained in a target body 15, preferably in brass.

In a particularly advantageous way, provision is also made for having the cavity 1 in which the target is positioned, exhibit a hemispherical shape, so as to adapt the energy distribution profile of the beam.

CLAIMS

1. A device intended for producing radio-isotopes, comprising a cavity (1) in which the target is positioned, characterized in that said cavity (1) has internal walls of a hemispherical shape.

2. The device according to claim 1, characterized in that it comprises an insert (8) in which the cavity (1) is made, comprising external walls (4), the shape of which is adapted to that of a diffuser (3) so as to create a channel (2) in which a coolant fluid moves.

3. The device according to claim 2, characterized in that the shape of the channel (2) created between the diffuser (3) and the external walls (4) of the cavity (1) is hemispherical.

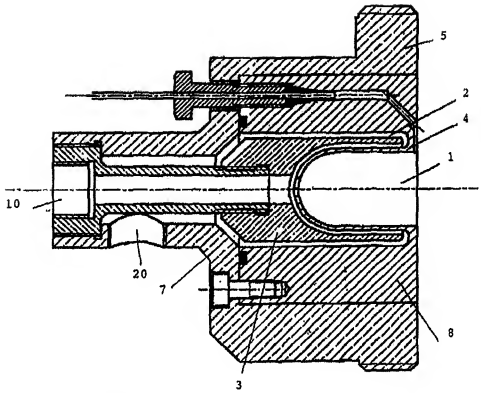

FIG. 1

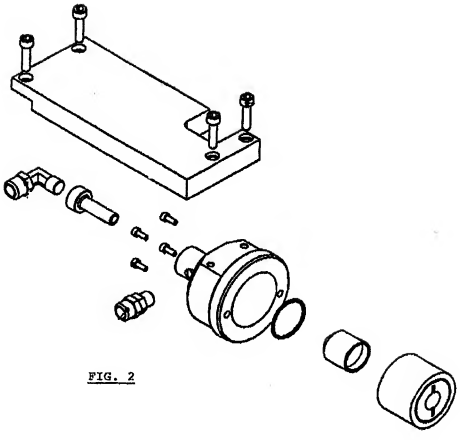

FIG. 2